

James M. Goodwin

TWO REPORTS

The Borrower will please return it when

MADE BY COMMITTEES APPOINTED BY THE

done with it

DIRECTORS OF THE ASSOCIATION

FOR IMPROVING THE

NAVIGATION OF CONNECTICUT RIVER,

ABOVE HARTFORD;

PUBLISHED BY ORDER OF THE BOARD.

HARTFORD, JANUARY, 1825.

HARTFORD :

P. B. GOODSSELL, PRINTER.

1825.

REPORT.

TO THE PRESIDENT AND DIRECTORS OF THE ASSOCIATION FOR IMPROVING CONNECTICUT RIVER ABOVE HARTFORD.

The Committee appointed "to examine and survey the obstacles in the navigation of Connecticut river, above Hartford; also to enquire into the most practicable method of improving said navigation, with general powers to act, in behalf of said Company, &c." respectfully Report :

That they have attended to the duties of their appointment, as fully as time and circumstances permitted. Their first attempt was to obtain from persons acquainted with the subject, a more accurate statement of the delays and difficulties attending the navigation of Connecticut river, than was at that time in their possession. An enquiry was instituted, with this view, the result of which, with some remarks of the Committee, was submitted to your board at their meeting in July last. To the communication then made, we ask leave to refer.

It was deemed proper that the survey directed by your board should be made by a skilful and experienced engineer, and one of the undersigned proceeded to Albany, to obtain the requisite assistance. Notwithstanding that information and aid were afforded, in the most prompt and friendly manner, by Gentlemen who had been long connected with the New-York canals, and by others; considerable delay took place, which was terminated by engaging Canvass White, Esq. of Troy, to direct the necessary surveys, and render such other assistance as should be in his power. This gentleman has been employed by the Commissioners of the New-York canals, and is highly esteemed in his profession. Under his direction a company was organized, for taking the necessary levels and surveys. After a general examination of the river from Hartford to Miller's falls, in Massachusetts, and of the improvements heretofore made; a minute instrumental survey was commenced at Enfield falls, in this State. Soon afterwards, Mr. White was recalled by sickness in his family, and detained more than a month, so that we have had less of his personal assistance than was expected. The levelling and surveying were, however, continued, under general directions from the principal engineer, and by persons familiar with the requisite operations. As these are unavoidably slow, as they can be performed, to the best advantage, during low water, and a rise in the river was to be expected the latter part of September, a selection was made of the most important points of examination, to which the surveying and levelling were confined. When, in the progress of our operations, we arrived at Hanover, in New Hampshire, the rains above had caused a considerable freshet in the river. At the same time, Mr. White was prepared to return, and complete a plan for locking Enfield falls, with an estimate of the expense, in doing which he required the presence of the assistant engineers, who had

taken the levels, and made the surveys, at that place. These considerations, with the lateness of the season, suspended the examination and survey of the river.

The falls at Enfield are about four miles in length, and are divided, by nearly one mile of slack water, into upper and lower; the former having a descent of ten, the latter of twenty feet. The current is rapid, the channel crooked, and in part very narrow, and the passage so difficult that the most experienced boatmen do not choose to attempt going down without a pilot, who is the only extra assistant required in descending the falls with rafts or boats. In poling boats up these falls, one man is required to each ton of lading. The expense is one dollar for every additional person employed. On some occasions, favorable winds render it unnecessary to hire extra hands, or diminish the number which otherwise would be necessary.

During many weeks, annually, the river is so low that boats fully laden cannot pass Enfield falls, and the consequent necessity of lightening such boats, occasions loss of time and additional expense.

The bed of the river at Enfield falls consists of slaty rock, which is broken up without much difficulty, and affords valuable stone for various uses. The upper falls are about one mile in length, and the banks are so high and rocky, as to forbid the construction of a canal out of the river bed.

The lower falls commence near the head of King's island, which is about one mile long. A high rocky bluff, with short interruptions, extends along and below the island, on both sides of the river, and is terminated, both on the east and west banks, by meadows, through which a canal may easily be made.

The cheapest method of making a slack water navigation by Enfield falls, would undoubtedly be by erecting a dam, or dams, across the whole river, on the lower falls, so high as to overcome the upper falls, with an embankment, canal, and locks, below the dam.

Objections, however, are made to this method, and it is not permitted by the charter granted at the last session of the Assembly of this State. It was therefore necessary to discover or adopt some other practicable method of passing the falls. To prepare for this, a running level was commenced on the east side of the river, at Parsons' brook, about one mile below Ware House Point, and continued above the upper falls. A continued level was also carried down the river on the west side, commencing below Lovejoy's ferry, passing by both falls, and terminating in deep water, at a place called the Walauts, nearly opposite the mouth of Parsons' brook.

Partial levels were also taken, both on the east and west side of the river, with a view to discover the best possible route for a canal, and a survey and map were made of the falls, and the adjacent country.

After the levelling and examination of the river in New-Hampshire were terminated Mr. White reviewed the ground, and the operations at Enfield, and furnished estimates of the expence of a canal by the falls at that place, in three modes. In all, it is proposed to pass the high and rocky shores by means of an embankment of earth, to be placed in the bed of the river, after the manner adopted in constructing that portion of the New-York western canal, which is formed within the banks of the Mohawk river. Two of the three methods

contemplate making the canal on the west side, and one on the east side of the river.

The first method proposes "to commence on the west side, at the head of the upper falls, with a substantial wing dam, to be continued along parallel with the shore, to a favourable point for a guard lock. From the guard lock, an embankment of earth, protected from floods and ice by a stone wall, must be constructed in the bed of the river, at a sufficient distance from the rocky bank, to form a canal. The embankment may be joined to the head of King's island, and the channel of the river, on the west side of the island, used for a canal, by constructing an embankment from the foot of the island to the main shore. This embankment must be continued along the shore to the bottom land. Thence to the foot of the fall or rapids, a canal can be excavated along the bank of the river, to a convenient point for locking down to the slack water."

The embankment from King's island, upward, is calculated to average twelve feet in height, which height is considered sufficient to carry it above floods, in that part of the river. The slope is to be such that the bank shall retire one foot and a half horizontally, for every foot of perpendicular rise. The slope wall to be built only on the side next the river. The embankment at the foot of King's island, and along shore to the bottom land, is to average twenty-three feet high, and to have an increased slope. According to this method, the cost is estimated by Mr. White as follows :

Guard lock and wing dam,	.	.	.	.	.	5,500
Embankment to head of [King's] island,	.	.	.	.	.	} 27,925 20
	139,626	cubic yds.	at	20	cts.	
Slope wall on the embankment,	10,480	do.		75		7,860
Embankment from island	} 113,328	do.	20			22,665 60
to bottom land,						
Slope wall,	4,336	do.		75		3,252
Waste weir for Pascoe's (or stony) brook and land floods,						2,370
Excavation in bottom land,	56,446	c. yards,		10		5,644 60
Embankment of ravines,	10,512	do.		15		1,576 80
Culvert for Haskell's mills,	.	.	.	.	.	1,500
Bridges, fencing, &c.	.	.	.	.	.	2,450
Three locks of 10 feet lift each, wood and stone,	.	.	.	.	.	6,000
Guard wall and wharf, below the locks,	.	.	.	.	.	1,500
						<hr/> \$88,244 20
Add for contingencies 10 per cent.	.	.	.	.	.	8,824 42
						<hr/> \$97,068 62

"Another plan for improving the navigation by a canal and locks on the west side of the river is, to construct a wing dam and embankment along the shore, to the foot of the upper falls, and then lock down into the slack water between the falls. A channel must be excavated in the bed of the river, near the head of King's island, and a dam constructed from the foot of the island to the main shore ; also a guard lock. An embankment must be made from the guard lock to the bottom land ; the embankments to be protected by a stone wall.

A canal may be excavated along the bottom land, but the cutting will be much deeper than on the first plan.

Guard lock and wing dam,		\$5,500
Embankment above the lock,	82,133 c. yards, 20 cents, }	16,426 60
Sloping stone wall,		
Lock, guard wall, and embankment,	6,200 do. 75	4,650
Excavating channel in rock,		3,000
Dam from island to main shore, 600 feet at \$10 per foot,		1,500
Guard lock and embankment,		6,000
Embankment from lock to bottom land,	28,123 c. yds. at 20 cts. }	2,500
Stone wall to protect the bank,		
Excavation, generally extra cutting, 123,370 c. yds. 12 cts.		5,624 60
Do. of Rock,	1,980	14,804 40
Embankment of ravines,	10,140 do. 50	5,070
Culvert for Haskell's mills,	3,617 do. 15	542 55
Bridges, fencing, &c.		1,500
Two locks, guard wall, wharf, &c.		2,450
		5,500
		<hr/>
		\$77,048 15
Add for contingencies 10 per cent.		7,704 81
		<hr/>
		\$84,752 96

It will be seen that the difference in the expence of these two modes of passing Enfield falls, is about fifteen per cent. Some advantages in favor of the first method are obvious. It will bring the whole lockage together, avoiding the necessity of a double attendance and detention. It will admit of a continued towing path of nearly six miles in length; and the water being carried through on a level ten feet higher than on the second plan, the power of the water privileges will be much increased, and in a great measure secured from interruption by freshets.

3. The third method contemplates passing Enfield falls on the east side of the river. Here, as on the west side, "the banks are principally composed of rock, but overlaid with sand, which will be very easy to excavate, for constructing the embankment along the foot of the ledge. The superincumbent earth on the west side is composed principally of gravelly loam and clay, excellent materials for embankments.

The canal should be constructed by forming an embankment in the bed of the river, as on the west side, to commence at the head of the rapids by a wing dam and guard lock. There are two places between the head of the rapids and Bullen's brook, (which joins the river below King's island,) that will permit the canal to be made on the shore, for a short distance at each place. From Bullen's brook the canal should pass along the foot of the bank a short distance. It will then leave the river and pass over ground very favorable for a canal."

The expence of constructing a canal on the east side of the river, by Enfield falls, is estimated as follows :

Wing dam and guard lock,				5,500
Embankment,	115,807 cubic yds.	18 cts.		20,845 26
Sloping stone wall,	7,612	do.	75	5,609
Excavation,	33,864	do.	10	3,386 40
Embankment,	43,883	do.	18	7,898 84
Stone wall,	4,148	do.	75	3,111
Embankment,	73,216	do.	18	13,178 88
Stone Wall,	4,222	do.	75	3,166 50
Excavation,	31,584	do.	12	3,790 08
Do. in bottom land,	28,400	do.	10	2,840
Bridges, fencing, &c.				2,450
Three locks, guard wall, wharf, &c.				7,500
				<hr/>
				\$79,275 96
Add for contingencies 10 per cent.				7,927 59
				<hr/>
				\$87,203 55

Respecting these estimates, Mr. White remarks, "that if stone locks are adopted, about twenty-five thousand dollars should be added to each. The prices allowed for the different kinds of work are such as will warrant the completion of the undertaking, allowing the price of labor and provisions to continue the same as at the present time."

The plans and estimates of the engineer, and a map of Enfield falls are presented herewith.

Upon either of the plans before described, the canal will finally enter the river nearly a mile below Warehouse-Point. Upon either, very valuable water privileges may be brought into use, in connection with the canal. From their location, and the unfailing supply of water, they would doubtless sell for an important part of the cost of the locks and canals. Some additional expense would be necessary, to make a canal of such dimensions as to afford a good navigation, and also furnish a large supply of water for hydraulic establishments.

In the foregoing estimates, nothing is set down for damages to land or other property. Should the first described plan of a canal be executed, a small cotton factory on Stony brook, would be deprived of its water privilege, which would also be, in some degree, impaired by constructing a canal according to the second plan. Were the third method to be adopted, some damage as well as benefit, might accrue to the owners of one or both of the distilleries on the east side of the river, near King's ferry.

From the head of Enfield to the foot of Willimancet falls, no survey or levelling was deemed necessary. The descent is very moderate, the water slack, the boating unobstructed by bars, and the channel of the river is represented by those best acquainted with it, to be never less than three feet deep, in the shoalest places, and at the lowest water. This part of the river is more easily and constantly boatable than any other portion of equal length.

The first obstruction to boating above Enfield, is found at the Willimancet falls, which are within the chartered limits of the proprietors of the South Hadley locks and canals. The Willimancet rapid is about one mile in length, and has, in that distance, a descent of nine feet. The bed of the river there, is rough and rocky, and the channel for boats and rafts, crooked. Hence a pilot is necessary to descend the

Willimancet falls safely, and is usually employed by all who pass those rapids with boats or rafts. In ascending, boats are drawn up by cattle, in an artificial channel, formed on the west side of the river, and there being no lock, the current is not destroyed. During a considerable period in every year, there is a deficiency of water in this artificial channel. The annual average time during which boats fully laden cannot, for want of water, ascend the Willimancet falls, is stated to be not less than three months. A lighter is provided, and kept at that place, by the corporation owning the South Hadley locks and canals, for the use of those who ascend the river with freight; and also a team for drawing up boats.

It is supposed that a good navigation cannot be made by the Willimancet falls, without a dam, or a canal, and a lock or locks. A canal was formerly constructed around these falls, at the foot of a high and abrupt bank, which makes down on the east side of the river. It was however soon obstructed by earth washed down the bank, by which it became wholly useless, and still remains so.

At very low water, boats cannot pass through the South Hadley canal with full loads. The most obvious method of removing this difficulty is, by giving greater depth to those parts of the canal where it is needed, or by raising the dam near the head, and by increased attention to removing the sand and earth deposited in the canal by freshets.

Immediately above the South-Hadley canal, and within the chartered limits of the corporation to which those works belong, there is a rapid current during floods, about three fourths of a mile in length, which, at times, renders it dangerous for loaded open boats to descend, and impossible to ascend. After the freshet has partly subsided, boats descend with safety, but to ascend additional help is required. In low water the passage is not difficult nor unsafe. The river at the head of this high-water rapid, is confined within rocky and uncommonly narrow banks, and this straitened channel is obstructed by large masses of rock. As the river descends it becomes gradually wider, until it reaches the dam erected for throwing water into the canal, where it attains a width twice as great as at the narrows above. But the same water which passes over the dam must first find its way through the narrows. The quantity is very great during freshets. The passage which is wanting in width, forces the water to rise up at the narrows. The water spreading itself and consequently falling, as it approaches the dam, the descent becomes so great during high water, as to produce a violent and dangerous current. We have obtained no plan, by which this, and the obstructions in the canal, and at Willimancet falls can best be removed. The falls at South-Hadley are separated by about one mile of slack water. A level was taken on the west side of the river from the top of the present dam, and continued, chiefly along bottom land, to the river below the Willimancet falls. The whole descent was found to be fifty-nine feet.

From the head of South-Hadley falls to the foot of Miller's falls, the water is represented to be generally boatable through the summer.—The principal obstructions are a bar at Stoddard's island, below Hadley; Schoolmeadow bar above Hatfield; and Cobb's bar, still higher up the river, the last being the most difficult of the three. In very low water, boats fully laden must lighten at Stoddard's island, and at Schoolmeadow, and in common years, at Cobb's bar, for about four weeks. Our information as to these bars is derived from persons accustomed to

boating, and not from personal examination. Other parts of the river were known to be much more obstructed, and the season most favorable for taking levels, along the river, might soon be past. The engineers, therefore, proceeded from South-Hadley falls to the foot of a succession of rapids, known by the name of Swift Water. There the levelling was re-commenced, about eight miles below Brattleborough. Next to Enfield falls, Swift Water is the most difficult and expensive part of the river navigation, in proportion to its extent, which is about twelve miles, beginning near a place called Cooper's rocks, and terminating at Leavitt's rock, several miles above Brattleborough. In this extent are nine principal bars, all quick, and part too shoal for loaded boats to pass during low water. The number of men required in poling boats up Swift Water, is one for every two tons of lading. The expense of extra hands employed here is two dollars each, for ascending with one boat. A level was taken by all these bars, and the distances, with the rise at various points noted, and preserved for future use. The whole ascent in the river from the foot to the head of Swift Water, is twenty-four feet, being two feet in the mile.

Between the head of Swift Water and Bellows falls, being an extent of twenty miles, are found a number of heavy bars. The whole rise is twenty-two feet. Less extra help is required than up Swift Water, but two or three additional hands are here deemed necessary to propel boats fully laden. Teams are occasionally used for drawing boats over some of these bars, and in low water, part are so shoal, that a boat with full freight cannot pass.

The distance from the foot of Swift Water to Bellows falls exceeds thirty miles. The rise is forty-six feet, averaging, very nearly, eighteen inches in the mile. About six miles of the thirty may be called slack water, the residue is partly slack and partly quick, but bars and shoals are frequent. In the worst places, a fall of three feet is found, sometimes, in less than a mile. The river bed consists chiefly of coarse pebbles, not easily removed by currents. From this fact some have entertained an opinion, that channels might be so excavated in the river as to afford a permanent and useful navigation, between Swift Water and Bellows falls. Upon a careful examination of these obstructions, seeing the velocity of the current, and in some instances the shoalness of the water, we are compelled to entertain a different opinion, and to believe that in those parts of the river now under consideration, a permanent and beneficial navigation cannot be obtained, without a canal, or dams sufficient to deepen the water on the shoals, and to destroy the rapids. Probably a good boating channel may be cleared, through a single bar, where the water above and below it has sufficient depth. But where bars are numerous, and near together, the descent, and consequently the velocity, cannot be destroyed without great expense, by any excavation of the bed of the river. If a bar should be wholly removed, the current is removed also, but not destroyed, being united with that in the bar next above. Deepen the river and overcome the current at the bar above, and the whole fall but begins higher up. If, however, a channel only wide enough for boats were to be excavated through the bars, and the surface of the water but little varied in the river, while a shoal might thus be removed, the velocity of the water, already too great, would be increased in the deeper channel.

From a cause before alluded to, the principal engineer was unable to visit Connecticut river above Miller's falls. Observations were, however, taken, and the width of the river calculated at several points where dams would probably be needed, if that method should be eventually adopted. The average length of dams required between the foot of Swift water and Bellows falls, would be about five hundred feet. The foundation of such dams must generally be laid in coarse gravel or pebbles, and probably, should be secured by driving piles. No estimate of the cost of such dams, with the necessary locks and canals was obtained.

The descent at Bellows falls is a little less than fifty feet. The works at that place for improving the navigation, consist of a low dam, a short canal, partly through very hard rock, with guard and other locks. The canal enters an eddy below the falls, and some delay and difficulty are experienced in getting rafts out of the eddy into the main current of the river. During freshets as well as at very low water, boats fully laden cannot pass the canal at Bellows falls.

The water above is made slack and deepened by the dam at Bellows falls, and is understood to be boatable at all times, about eight miles. This was passed by, without a survey, and the levelling re-commenced near the head of the pond, below the bar called Fort Ranger, and continued with little interruption to Water Quechy falls. In this distance, being about twenty-three miles, the fall was ascertained to be thirty-one feet, or sixteen inches in the mile. This fall is unequally distributed among various bars and shoals, which in general character, are similar to those below Bellows falls, and seem to require improvement in a similar way.

At Water Quechy, the fall is twelve and a half feet. The improvements at that place consist of a dam, a very short canal, and one lock. During floods boats cannot pass these works, nor during low water.

From the Water Quechy lock to White river falls is nine miles, the lower half of which is slack water, and boatable. In the upper half are several bars, and the whole fall was supposed, from running a level through, and allowing for a rise which had taken place in the river during the operation, to be seven feet. It seems probable that this will require to be improved by a canal or a dam, and a lock, in a manner similar to that suggested for the rapid water below.

At the White river falls, the descent is nearly thirty-six feet. The works at that place consist of two dams about half a mile asunder, with three locks at the upper and two at the lower dam. Boats cannot pass these locks during high water, nor during many weeks, annually, of low water.

At White river falls, the operations were suspended for reasons already mentioned, and other engagements of the engineers prevented a renewal of the surveying, after the estimates for Enfield falls were completed. The season was, also, so far advanced that little more could be done, advantageously, the present year.

From White river to the head of boat navigation is a distance of more than fifty miles. By persons acquainted with the river, the boating is represented to be less obstructed by shoals and rapids than below Water Quechy, and Bellows falls, and the whole descent is conjectured not to exceed thirty feet.

It is believed that the whole fall between Hartford and Wells' river does not exceed four hundred feet. The principal rapids and bars have been measured with instruments esteemed accurate. The result, with a few conjectural estimates, is as follows :

At Enfield, Connecticut,	30 feet
South Hadley, including Willimancet,	59
Miller's falls,	71
Swift Water, and thence to Bellows falls,	46
Bellows falls,	48 6 in.
Thence to Water Quechy,	31
Water Quechy,	12 6 in.
Thence to White river falls,	7
White river falls,	36
Thence to Wells' river, <i>supposed to be</i>	30
	<hr/>
	371 feet.

No allowance is here made for the descent in the river between Hartford and Ware House Point, between the head of Enfield and the foot of Willimancet falls, nor between the head of South Hadley and the foot of Miller's falls, nor for the small descent which exists in the ponds formed by the dams at Miller's, Water Quechy and Bellows falls. It is not, however, from personal examination, but from descriptions and information from others, that we are led to believe that the fall in those portions of the river last mentioned, will not exceed the twenty-nine feet, wanting, to give four hundred feet descent in the whole.

Of this fall in the river, the existing locks and canals occupy the following portions, viz. at

South Hadley,	50 feet
Miller's falls,	71
Bellows falls,	48 6 in.
Water Quechy,	12 6
White River,	36
	<hr/>
	218 feet.
If we add to these, Enfield falls,	30
Willimancet,	9
Swift Water,	24
	<hr/>
Amounting to	281 feet,

And consider the whole descent from Wells' river to be 400 feet, there will remain a fall of one hundred and nineteen feet, which is unequally distributed through those parts of the river not above enumerated. The whole distance from Hartford to the head of boat navigation, is supposed to exceed two hundred and fifty miles in the course of Connecticut river. The rapids which, together, occupy the before mentioned fall of 281 feet, are in part concealed by ponds, and their exact length not known. It is, however, considerably less than fifty miles, and consequently more than 200 miles remain, in which the fall is supposed not to exceed 119 feet, or seven inches in the mile, averaging the whole.

The obstacles to the navigation of the river, in its present state, appeared to us greater than we had expected to find them ; and to obtain a useful and uninterrupted navigation, much must be done to improve the river, as well as the locks and canals heretofore constructed. If the present locks and canals were made perfect, and the other parts of the river were not improved, some benefit would arise. So if all the other parts of the river were made completely and constantly navigable, the existing locks and canals remaining in their present condition, some advantages would be experienced. But we are persuaded that neither by itself, will effectually supply what is wanting to a cheap and expeditious communication, from the more distant parts of the valley of Connecticut river.

Should the mode of levelling the water by dams be found expedient, we have seen nothing which will prevent obtaining an uninterrupted depth of three feet, in those parts of the river which we have examined, especially from the foot of Swift Water to White river falls. It will probably require a number of additional low dams, in the state of New-Hampshire, to make this depth of water secure, and overcome the shoals and currents. The sites, the permanency, and the cost of such dams, with the necessary locks, are for the consideration of persons who are familiar with such subjects, and will doubtless require a careful examination of different parts of the river. Prudence seems to require, that the best lights which science and experience afford, should be obtained. The most complete improvement of river navigation by dams, canals and locks, hitherto executed in the United States, is supposed to be on the Schuylkill river, above Philadelphia. In the distance of 110 miles, we are well informed that the fall in that river exceeds 600 feet, averaging three feet to one foot of fall in the Connecticut river. That navigation is now about to be opened, and lacks the test of experience. Much knowledge has, doubtless, been acquired, in the course of improving the Schuylkill, which would be useful in case similar works should be constructed on Connecticut river.

Should a complete improvement of this river be undertaken, by dams, locks and canals, the endeavor would be to guard against every interruption of the navigation by injuries to the dams and other works ; and as the number of dams must be increased, their durability and permanency should be secured with the greatest care. They should be, if possible, constructed so as to resist the effects of ice and of freshets, the two most formidable obstacles to a constant river navigation, improved by dams. After every improvement shall have been made, it is reasonable to anticipate some interruption of the ascending navigation, during the height of freshets. The current would also be more unequal during high than low water. It has been fully shewn to us, that great changes take place in the quick water, as the river rises or falls. Some bars which had several feet of descent, in the low state of the river when examined by us, wholly disappear during a flood, and the current becomes comparatively slow. A rapid is then formed, at no great distance, where none existed before ; or the swift water is extended and equalized over a much greater space than during low water. These variations in the rapids are caused by the windings in the channel, or by variations in the distance of the banks, or by both. During low water, the descent, and consequently the

current, are greatest where there is the greatest descent in the bed of the river. Many places within the banks are, comparatively, narrow. These produce the effect of dams, to a certain extent, and the strongest currents, during floods, will generally be found in passing from narrow to wider parts of the river. This consequence will not be prevented by dams, although the water should be so raised as to remain nearly level, when low. High freshets are not often of long duration, and it is only during their continuance, that inconvenience will be felt from that cause.

It may be asked whether, if the river were raised and the water levelled by dams, new obstructions might not arise by the formation of new bars? The chief cause of such an apprehension would be from gravel, brought into the river from the beds of its tributary streams. In several instances bars have been suddenly formed, in that manner, within the recollection of persons from whom this information was received. After enquiry, however, we do not believe that any great danger exists from such a source. The beds of the tributary streams are worn low, near the river. Many of them have dams erected at their mouths. The accumulations of gravel and earth from side-streams, will be less considerable, and less frequent than formerly.—And should a new bar be formed in this manner after damming and levelling the water, it would not probably be difficult nor expensive to remove it.

The highest point to which boats have, hitherto, ascended Connecticut river, is Barnet, in Vermont. Lumber is floated down from different towns above that place. From Barnet, Connecticut river ascends, in a more easterly direction, to a lake of the same name in New Hampshire. After a good navigation shall have been made, as far up as Wells' river, or Barnet, it will be desirable to have the Connecticut river explored, and to improve the navigation as far towards lake Connecticut as may be practicable.

The sources of the Pasumpsick river lie north and north-west of Barnet, and they approach and interlock with the principal waters which discharge themselves into lake Memphramagog; viz. Bellefleur pond in Barton, Willoughby lake in Westmore, and the Clyde river in Random. A survey will be necessary to determine the best route for connecting the Connecticut river with lake Memphramagog. The Clyde is represented to be a gentle stream, and the country through which it passes so flat, that a single dam near its mouth, sets back its waters about twenty miles. More than half of lake Memphramagog lies in Canada. It is about forty miles long, and has sufficient depth for good navigation. It is needless to speak of the benefits, which would result from a continuous and easy navigation from Long Island Sound to that lake.

In exploring the valley of Connecticut river, other plans of improvement force themselves on the attention. A small expence would render several of the tributary streams navigable, to the great benefit of towns adjoining the river. An instance may be mentioned at Northampton, where a lock and low dam, at the mouth of a small stream, would enable boats to approach the centre of that flourishing town. Similar advantages may be extended to Deerfield, and other towns. These instances are not mentioned from a wish to divert attention from the principal object. But when an unbroken navigation

between Long Island Sound and lake Memphramagog, or even Wells² river in Vermont, shall have been completed, many secondary improvements, of the kind just alluded to, will deserve to be examined, and will doubtless be executed.

We have now presented a general view of such obstacles in the navigation as we have been able to examine. The field books of the engineers, and many details relative to the different rapids and bars, which will be useful in the event of improving the river, are preserved, and will be furnished to the board of Directors.

In a former statement to this board, the opinion, held by many others, was expressed by us—that great improvements in the present locks and canals, as well as in the river generally, were indispensable to render Connecticut river the thoroughfare of the principal products of its valley; and that the necessary improvements would not probably be effected by a number of companies, having separate interests.—That opinion has been confirmed by our examination of the river, and if correct, the necessity of acquiring the right to improve the navigation by those falls where locks and canals already exist, is obvious.—With regard to some of those works it is indispensable, and as to all desirable, to obtain the control by negotiation, if it can be done upon just and equitable terms.

Further corporate rights and powers will also be necessary, to obtain which, memorials have been presented by sundry citizens of New Hampshire and Vermont, to the Legislatures of those States respectively, and it is supposed that those memorials will be acted on during the present month.

It may, for a moment, be assumed that all necessary rights and powers have been obtained, and the navigation so improved as to be easy, and subject to little or no interruption, except during winter. In what manner can boats be propelled, so as to give a decided advantage to transportation by the river, over that by land? Favorable winds are uncertain—the labor of men is dear—and the method of poling boats lacks expedition, although for short distances, these objections are not formidable. But in ascending two hundred or even one hundred miles of this river, the expence and delay attending the present method of propelling boats will ever be considerable. Some enquiries have, in consequence, been instituted respecting the use of steam boats in shoal water, and letters have been addressed to several gentlemen, requesting information on this subject, especially with respect to the practicability of towing by means of steam boats. Oliver Phelps, Esq. in his reply states, that he has been the owner of a steam boat, plying on the Cayuga lake, ever since the year 1819, of nineteen horse power, and 120 tons burthen, her draught of water being four and a half feet. That her speed in a still lake, or with a light wind, without boats in tow, is about seven miles an hour, with three or four boats, about five miles, and with ten boats, carrying 200 tons, from three and a half to four miles. In a heavy wind three or four boats are as many as are generally taken, and, if ahead, the progress does not exceed three or four miles an hour.—That it is always practised to tow all the boats in a line after the steam boat, that her lee-way is not great in a side wind, and the width of Connecticut river will be no serious objection. Mr. Phelps adds, that the only difficulty he apprehends is in the depth and current of this river, and expresses

his opinion as to the best method of building steam boats for our purpose. This letter, and another on the same subject, from D. Prentiss, Esq. of Louisville, Ohio, accompany this statement.

In August last, one of the undersigned witnessed the operation of a horse tow-boat, which was in use on the North river, between fort Edward and fort Miller, the distance being eight miles. The tow boat was built sharp, was fifty-seven feet long and eleven broad, with a platform extending beyond her sides, and when worked with four horses her draught of water was from twenty to twenty-two inches.—Seven loaded canal boats, carrying from 25 to 30 tons, each, had been towed down the river at one operation, and four against the current, which was moderate. The average progress was two miles an hour. The boats in tow followed the horse boat, one after the other, and were managed with apparent ease. The progress of the boat was confessedly too slow, and the power insufficient to answer the end in view, in the best manner.

We have reason to expect further information on this subject. After all, the best size, proportion, form, and power of the boat, as well as her success, must be in some degree matter of experiment. The principal difficulty apprehended is from the shoalness of the water, heretofore assumed at two feet of depth, which has been supposed to be certainly attainable, at all times. In case of a general improvement, it is believed that a depth of three feet can be had during the lowest water, from Miller's falls to the head of boat navigation and in all the canals. An equal depth is found at all times between Enfield and South-Hadley falls. Not having made a minute examination of the river, from South-Hadley to Miller's falls we give no opinion respecting the depth which can there be attained, and rendered constant. In all places having three feet depth of water, the success of a steam boat for towing, or for carrying freight, will hardly admit of a doubt. And there is reason to believe that a tow boat may be advantageously used in water less than three feet deep.

In this and our former report we have presented such obstacles to the navigation of Connecticut river as were discovered by examination, or were represented to us by persons in whom confidence can be reposed. The knowledge of these obstacles is yet incomplete. Errors may perhaps be discovered in the statements of others, or in our own observations. It should not be disguised that the obstacles appear to be numerous, and that the cost of removing them, though at present uncertain, will be considerable, probably greater than some persons have conjectured. But the importance of the object is also great. Neither is this city alone interested. More than 200,000 inhabitants in New-Hampshire and Vermont besides a numerous population in Massachusetts and Connecticut, would be, at once, benefitted by a cheap, expeditious, and durable water communication between Hartford and Wells River. One such communication, and only one is needed, and the great features of the country, the course of mountains and rivers, designate the valley as the natural outlet.

The great examples and exertions of other states are known. In New-York, the northern or Champlain canal is in full operation. Much of the western canal is finished. In less than a year it will be joined to Lake Erie and completed.

The Union canal in Pennsylvania, and the Chesapeake and Delaware canal, are in a course of successful execution. The Schuylkill navigation is nearly completed. Virginia, Ohio, and other states, are procuring surveys for canals, improving rivers, and extending internal improvements. During the past summer \$30,000, appropriated by Congress, have been expended, chiefly in exploring canal routes between the Potomac and Ohio, and the Alleghany and Susquehannah rivers. Appropriations were made at the last session of Congress for purposes connected with the improvement of the Mississippi and Ohio rivers.

Considering what has been accomplished, how much will certainly, and how much more will probably be done in other states, is not a further reduction in the value of property in New-England to be expected, especially in the value of land and its products, lying distant from market? Will not the New-York canals alone materially contribute to this result? From Buffalo to Albany is 362 miles. The tolls on flour grain, meal, salted provisions, pot and pearl ashes, are fixed at \$1 50, a ton per hundred miles. It is believed that freight can be afforded for \$1 50 a ton per hundred miles, and at those rates the whole cost of transportation, including tolls, will be \$10 86 from Buffalo to Albany. The accustomed route of produce from Brattleborough, from Wells River, and the intermediate towns lying near Connecticut river, is over land to Boston. The distance varies from 96 to 140 miles, and the ordinary price of transportation from \$12 to \$25 per ton, according to the distance, season of the year, and state of the roads. The average cost of carrying produce and merchandize to and from that section of country, is between \$16 and \$20 per ton. When the western canal is completed, the shores of Lake Erie will, in effect, be nearer to New-York, than Wells River, or even Brattleborough is to Boston, and every class of citizens, near Connecticut river will feel the effects of a competition between the products of this region, and those of the extensive, cheap, and fruitful lands of the western states; and must hereafter meet that competition in all the great markets of our country. What remedy have we then but to make internal improvements, and cheapen the price of transportation? And can these ends be effectually attained, by small efforts, by slight or partial improvements of the navigation? Large sums of money have been heretofore expended at some of the most difficult passes of the river. The works, however, belonged to different companies, acting for separate interests, and not professing to make a *general* improvement of the river navigation. And notwithstanding all that has been done by the proprietors of the present locks and canals, the amount of transportation on the river has diminished since their construction. The boating from above Miller's falls was considerable, twenty years ago. It is now comparatively trifling, and in a few years more will, probably, be almost if not wholly abandoned. The principal causes which have produced this result are improvements in roads, a reduction in the price of land carriage, and some diminution of water in Connecticut river. The fact that the navigation above Hartford has declined, notwithstanding a large expenditure in partial improvements, seems to be full of instruction, and to prove with the certainty of experience, that divided operations, and small efforts to improve the river, will not sup-

ply the great want, a cheap and expeditious carriage to and from market.

Believing that a thorough and general improvement of the navigation, is the most deserving object of attention, and seeing the extent of country through which it must be made, and the number and variety of obstacles to be overcome, if we may express our solicitude on this occasion, it is, that the previous investigation should be careful and complete, in proportion to the importance of the subject, and that the best opinions, of at least two experienced engineers, possessed of all requisite facts, and enlightened by personal examination of Connecticut river, and its valley, should be obtained.

Were the interests which depend on an improved navigation small or doubtful or temporary, a mistake or even failure, would be chiefly injurious to those who should invest their money in the undertaking. But the interests to be promoted by success are great, certain, and permanent; extending to a numerous and increasing population, and embracing the welfare of future generations. These interests justify and seem to demand the most persevering, and complete investigation, which care, and science, and experience, can effect; and it is only after such an investigation has been completed, that a plan for an improved navigation, either by way of the river, or by an independent canal, can be adopted with confidence of profit to those who shall execute it, and utility to the public.

DAVID PORTER,
ALFRED SMITH.

Hartford, November 18th, 1824.

At a meeting of the Directors of the Association, in November, the foregoing report was accepted and approved, and a committee was thereupon appointed "to enquire and report what further measures are expedient to be adopted to accomplish the object of this association." At a subsequent meeting of the board the following report was presented by the committee appointed for that purpose, and was accepted and approved.

TO THE PRESIDENT AND DIRECTORS OF THE ASSOCIATION FOR IMPROVING CONNECTICUT RIVER ABOVE HARTFORD.

The Committee appointed "to enquire and report what further measures are expedient to be adopted to accomplish the object of this association," respectfully Report:

That, in their opinion, a general and thorough improvement of the navigation is required by the interests of those who inhabit the valley of Connecticut river, and is an object worthy of the first and most persevering attention.

That the interest in all works necessary to a thoroughly improved navigation should be consolidated, and placed, virtually, under the control of a single company, upon terms which may afford a reasonable remuneration for the expence and hazards of the undertaking, but so guarded and limited as to secure to the public the greatest benefits, consistent with such remuneration. Several measures require to be taken, preparatory to the formation of such a company.

1. Certain existing corporate rights and property must be purchased ; or adequate methods of passing the rapids where locks and canals already exist must be found, and which shall not violate such corporate rights.

At South-Hadley and at Miller's falls, the rapids are long, the portage is difficult and expensive, and at neither place can a road or rail-way be advantageously substituted for water carriage. It is, therefore, an object of the first importance, to secure the rights of the corporations which have constructed locks and canals at South-Hadley and at Miller's falls.

Until, however, the contemplated plan of general improvement shall have been matured and adopted, the question as to an absolute purchase of those works, cannot be decided. A conditional contract, therefore, is wanted, which shall bind the proprietors to sell at a fair and fixed price, provided the terms shall be complied with by the other party, within a reasonable time to be limited in the contract.

The time for accepting and complying with the terms, should be sufficient to admit of making a complete and detailed plan of all necessary improvements, with estimates of their cost, and of afterwards procuring subscribers, organizing a new company, and raising the necessary funds. To obtain the requisite plans and estimates will require considerable time, on account of the number and variety of obstacles to the navigation which must be overcome, and which must be carefully examined by professional engineers. Further levelling must also be done, and surveys procured. The time which will be necessary to prepare for and form a company, cannot be precisely foreseen.

Other facts exist which may require considerable delay, in deciding whether to accept such terms as may be obtained from the proprietors of the locks and canals at South-Hadley and at Miller's falls. Prosecutions are depending in the supreme court of Massachusetts, against the corporations which have constructed canals by these falls, drawing in question the rights of those companies, under their respective charters. An indictment is, also, depending in the same court, on account of the erection of the dam, by means of which the South-Hadley canal is supplied with water. Should this prevail, the dam will probably be removed, and the canal rendered useless, until further expenses shall be incurred. There is no reason for believing that the proceedings against those corporations will be terminated before September, 1825, and a final decision may be delayed beyond that time. The grounds of defence are better understood by the present companies, than they could be by a new company. Persons who would, otherwise, be willing to become purchasers of those works, may not choose to take the burden of a defence, the merits of which they do not understand ; and it might, hereafter, prejudice a new company to have substituted itself as a party to the pending prosecutions, and voluntarily placed itself in conflict with interests excited in behalf of the fisheries, in Massachusetts.

Hence it is desirable to obtain the refusal of the works at Miller's and at South-Hadley falls, for a time which shall extend beyond the termination of all proceedings depending against either corporation.

In New-Hampshire, three incorporated companies have acquired rights and constructed locks, at as many different rapids in the river.

It is believed that if the interest in those works cannot be purchased on reasonable terms, a substitute may be provided which will supply the want of them.

The portage by Bellows falls, is about 130 rods long, and the common price of cartage is twenty-five cents per ton, while the toll charged for passing the canal at that place is eighty cents per ton. With proper improvement of the road, and more constant employment, it is believed that the price of land carriage may be considerably reduced, and that suitable machines may be introduced, for transporting boats and lumber by those falls, without damage. It is desirable, however, to purchase and improve the locks and canals, if that can be done upon just and equitable terms.

A majority of the proprietors of the lock and canal at Water Quechy, have manifested a disposition to encourage the improvement of the navigation, and have given terms which will serve as a favorable basis for negotiation.

Most of the stock in the White river Company has been offered for sale, but upon terms which render it interesting to know whether any, and what rights are left to the public, and how far the control of the navigation by the White river falls, is vested in the Corporation.

The White river Company was authorized, by charter from New-Hampshire, to construct locks and canals, but was expressly prohibited from obstructing the road used as a portage by those falls. One of the two dams erected by the company, threw the water over a part of that road and rendered it useless.

The company was permitted to demand and receive, for a period of twelve years, whatever tolls they should see fit for the passage of property through their locks and canals. The price taken has been one dollar per ton for freight, and the same sum for each thousand feet of lumber. There is reason to believe that works fully equal to those now at the White river falls may be constructed for less than \$15,000. The rate at which they have been offered, is \$50,000, which seems to be predicated on the income derived from them, while the Company had the right of fixing the amount of tolls which should be paid. The twelve years during which this was allowed, have elapsed, but the legislature of New-Hampshire has not yet exercised its right of regulating the tolls to be taken by the Company.

It is believed, by persons conversant with the legislation of Vermont, that no charter is in force from that State, to the White river Company. The west end of the dams, and land on the west side of the Connecticut river flooded by those dams, are within the jurisdiction of Vermont, and should there be a disposition to defeat the project for an improved navigation, or to charge it, and consequently the public, with unreasonable burdens, the authority of that state may afford relief, so far as it has not granted away its rights.

A road may be made, on the Vermont side, by the White river falls, from the upper pond to the lower eddy, over favourable ground. It would require to be about two thirds of a mile long, and property could be transported over such road, for much less than the tolls heretofore charged by the White river Company.

If a negotiation for purchasing the works of the White river Company should prove unsuccessful, it is believed that the public have rights left, which may afford a valuable substitute for the locks and canals in question.

As a binding contract cannot be made in the name of a voluntary association, not incorporated, it is recommended that the Connecticut river Company be organized, for the purpose of negotiating with the proprietors of locks and canals on Connecticut river.

II. Before the question as to undertaking a thorough improvement of the river navigation is settled, the survey of the river ought to be completed, and detailed plans, with estimates of all expenses, be obtained from experienced engineers. Then it may appear what amount of stock must be raised to accomplish the object, and whether the probable benefits of the navigation will justify the necessary expense. As at present informed, we think that the survey of the river should be suspended, until it is ascertained whether all necessary corporate rights, heretofore granted, can be secured to a new company, upon just and reasonable terms; and also that the project for a thoroughly improved *river* navigation, must be suspended or abandoned, unless a suitable contract be made, for the control of a part of those corporate rights. It is very desirable that the negotiation for the refusal of those rights should be entered upon and concluded as soon as practicable, to afford time to make arrangements for further surveys, during the winter, and with as little delay as possible. So many canals are contemplated in our country, that the best engineers cannot easily be procured, in summer, as they are generally under indispensable engagements at that season of the year.

It is a question whether future surveys should be confined to the river, or a route for an independent canal should also be surveyed, and the expense of constructing such canal estimated, before deciding the method of improving the navigation. If this should be deemed expedient, the necessity of early arrangements to secure suitable engineers, would be very pressing. The expense of such survey, with estimates, must be considerable, and would form the principal objection to its being undertaken. It should be understood that some, upon the information now possessed, are in favour of an independent canal. Others believe that the whole subject should be explored, and estimates obtained of the cost of improving the river, and also of an independent canal, before finally deciding on a subject of such deep interest to the inhabitants of this valley.

Two cases may be supposed, in either of which a survey for an independent canal may be recommended.

1. That the Congress of the United States may make appropriations for internal improvements, from which the expense of such survey may be defrayed. Considerable appropriations have heretofore been made by congress, and expended for similar objects. Others may be expected, and if the importance of an improved navigation through this valley shall be suitably represented, its inhabitants will doubtless obtain their reasonable part of future appropriations.

2. Some of the present charter privileges are deemed indispensable to a general improvement of the river navigation, in the manner before recommended. If it shall appear, after a fair trial, that the co-operation of the proprietors of existing locks and canals cannot be procured, upon equitable principles, and on such terms as shall lay a foundation for forming a new company, measures may then be taken, and a survey for an independent canal be made.

III. It will, eventually, be found necessary to obtain additional pow-

ers from part or all of those states, within which the navigation needs improvement. When the survey of the river, or for an independent canal, shall have been completed, and detailed plans of the requisite works obtained, memorials can be framed, and charters devised to meet the exigencies of the case. The interests of the public, and the rights of proprietors, can both be protected by suitable legislative acts. At the same time provisions may be introduced, which shall, in some degree, simplify the management of property held by grant from four independent jurisdictions.

IV. Most of the late measures for improving the navigation have originated in this place. Public attention has, however, been called to the subject in states lying north of us, and a general feeling exists in favour of the proposed improvements. It is perceived that the interest in this subject is not confined to one town, nor to one state. Is it not time that measures should be taken to extend and embody the feeling, which exists throughout the valley of Connecticut river, in favour of an improved navigation, and for this purpose to invite a meeting of citizens to be held, during the ensuing winter, at some central point in the valley? Much knowledge of the interests to be promoted and protected would thus be brought together, and a report proceeding from such a meeting would tend to inspire confidence, and encourage future exertions, and by its influence on public opinion, might hereafter be of essential service.

Your committee are happy to have it in their power to observe, that from the surveys and levels already taken, there appears no such obstacle to an improved navigation of the river, as to render the success thereof doubtful, at an expense which the object sought after would fully remunerate and justify.

They, therefore, submit the following measures, as deserving of adoption by this Board, and recommend that committees be appointed to carry them into effect.

1st. For procuring the Connecticut River Company to be organized under the charter granted by the Legislature of this State; that said company may endeavor to obtain the refusal of the stock of proprietors of locks and canals on Connecticut river, on reasonable terms, and for so long time that such stock may, eventually, be made part of the stock of a new company, (if the proprietors thereof see fit,) for improving the navigation of the river.

2d. To obtain for this section of our country a reasonable part of such appropriations as shall be made by Congress, for the purpose of internal improvements, and to procure a survey of Connecticut river, or of a route for an independent canal through its valley, or both, to be made by the engineers, or at the expense of the United States.

3d. To take measures preparatory to a meeting of citizens from all the towns on or near the valley, in the several states interested in the navigation of said river, and to procure such meeting to be called at some central point, whenever circumstances shall render it expedient.

4th. To cause to be printed the reports of the committees, or so much thereof as shall be deemed interesting to the public.

Respectfully submitted.

DAVID PORTER,	}	<i>Committee.</i>
WM. H. IMLAY,		
ELIPHALET AVERILL,		

After the foregoing report was presented and accepted, the following votes were passed by the Directors of the Association.

Resolved, That, in the opinion of this board, it is expedient for the Commissioners of the Connecticut River Company, to proceed without delay to organize said Company, under their charter from the General Assembly of this State.

Voted, That Thomas S. Williams, David Porter, and William H. Imlay, be a Committee, to endeavor to obtain for this section of country, a reasonable part of such appropriations, as shall be made by Congress for purposes of internal improvement, and to procure a survey of Connecticut river, or of a route for an independant canal through its valley, or both, to be made by the engineers, or at the expence of the United States.

Voted, That David Porter, John Russ, and Eliphalet Averill, be a Committee to take measures preparatory to a general meeting of citizens from all the towns on or near the valley, in the several states interested in the navigation of Connecticut river, and to procure such meeting to be called, at some central point, whenever circumstances shall render it expedient.

At a full meeting of the members of the Association, subsequently held at the State House in Hartford, the foregoing reports were read, and the resolutions of the Directors approved.